

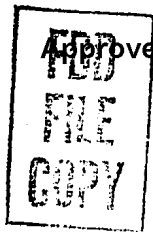
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~~UNCLASSIFIED~~ INFORMATION ON SOVIET
BLOC INTERNATIONAL GEOPHYSICAL COOPERATION
- 1960

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INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1960

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM--
SOVIET-BLOC ACTIVITIES

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I. GENERAL

New Geophysical Observatory in Belorussian SSR

A new geophysical observatory has been created in the system of the Academy of Sciences Belorussian SSR, under the Institute of Geological Sciences. Its task will be the study of the geomagnetic, geoelectric, and gravitational fields and of microseismic oscillations of the Earth's crust.

The observatory is located in Pleshchenitsy. Electrical and magnetic pavilions have been built, and a laboratory and living quarters for the scientific associates are being completed. The building of the seismic and gravity pavilions is planned. The geophysical observatory is equipped with new apparatus and corresponding equipment which make it possible to conduct investigations on the modern scientific-technical level.

Observations for short-period geomagnetic variations are now being conducted at the observatory. The organization of stationary gravimetric and seismic observations and the continuous recording of Earth currents are specified for the future. The stationary magnetic station in Pleshchenitsy is included in the network of permanently operating stations in the Soviet Union, a fact which boosts its scientific and practical significance.

Considerable organizational and scientific-methodical aid was rendered to the Institute of Geological Sciences in the creation of the observatory by the Presidium of the Academy of Sciences Belorussian SSR, the Interdepartmental Committee for the Conduct of the IGY, the Institute of the Physics of the Earth imeni O. Yu. Schmidt of the Academy of Sciences USSR, and the Scientific Research Institute of Terrestrial Magnetism, the Ionosphere, and Radiowave Propagation [NIZMIR]. ("New Scientific Research Institutions"; Moscow, Vestnik Akademii Nauk SSSR, No 11, Nov 59, p 70)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Sodium Cloud Pictures Win Awards for Members of Kazakh Institute

The Presidium of the Academy of Sciences Kazakh SSR has recognized the great work conducted by the associates of the Astrophysical Institute on the observation of artificial earth satellites and cosmic rockets and, in particular, on the observation and photographing of the motion of the second cosmic rocket aimed at the Moon.

Several clear photographs of the sodium cloud formed by the second cosmic rocket were obtained on 13 September 1959 by the associates of the institute. The time of the beginning of the flare, according to the pictures obtained by the institute, was reported by Tass as 2148 hours Moscow time.

In view of the uniqueness of the obtained material and the successful conduct of the sodium cloud observations, the Presidium of the Academy of Sciences Kazakh SSR resolved to declare its thanks and to distribute a monetary award to the following associates of the institute: M. G. Karimov, assistant director; D. A. Rozhkovskiy, head of the Division of Astrophysics; V. S. Matyagin, A. V. Kurchakov, M. A. Svechnikov, and T. B. Omarov, junior scientific associates; K. G. Dzhakushev, senior laboratory assistant; and E. S. Yeroshevich, laboratory assistant. ("Best Photographs of the Sodium Cloud"; Alma-Ata, Vestnik Akademii Nauk Kazakhskoy SSR, No 11, Nov 59, pp 97)

Sputnik III -- 9,000 Times Around the Earth

At 0027 hours Moscow time, 1 February 1960, the third Soviet artificial satellite completed its 9,000th revolution of the Earth. Sputnik III has been in flight for 626 days. During this time, it has traveled 408 million kilometers.

The orbital period of the satellite has decreased by 13.1 minutes and is now 92.85 minutes. The daily change in the orbital period is five times greater than its initial value and will grow even higher in the future. The apogee of the satellite's orbit has dropped from 1,880 kilometers down to 640 kilometers.

The satellite's radio transmitter "Mayak," operating on a frequency of 20.005 megacycles, steadily continues to send signals during the satellite's movement in those parts of the orbit illuminated by the Sun. As has already been reported, the chemical sources of power have ceased functioning. Power for the transmitter comes only from the solar batteries.

Radio and optical observations of the satellite's flight are being continued. ("9,000 Revolutions of the Earth"; Moscow, Pravda, 1 Feb 60, p 1)

III. OCEANOGRAPHY

Underwater Television

A method of studying the depths of the sea by means of remote-controlled television is claimed to have been developed by the Black Sea Scientific Research Experimental Station of the Institute of Oceanology of the Academy of Sciences USSR.

A metallic bathysphere containing a television transmitter (connected by cable to the television receiver on board) is lowered by winch from a ship. A specialist sitting before the televisor conducts observations and controls the apparatus with a manual remote control. ("Underwater Television"; Moscow, Nauka i Zhizn', No 11, Nov 59)

IV. SEISMOLOGY

Seismic Data on the Structure of the Earth's Crust in the Central Part of the Black Sea

In the summer of 1958, regional seismic studies were conducted in the central part of the Black Sea for defining the structure of the Earth's crust in this region. In addition to the authors, taking part in the work were G. N. Shchipletsov, V. M. Kovylin, and V. V. Petrov.

As can be seen from the drawing of the location of the seismic profiles (Figure 1), the region of operations embraced the central part of the deepwater depression of the Black Sea and the zone of the continental slope to the south and southeast from the Crimean peninsula. A detailed echometric survey of the bottom of the region was conducted simultaneously with the seismic work.

The continental slope along the shore of the Crimea from Sevastopol to Feodosiya is sharply divided into two parts, according to the nature of its relief. The boundary between them is in the region of Yalta and Gurzuf and is expressed by curves of the isobaths. The continental slope of the eastern part is steep and dissected by numerous, but short, troughs, obviously of tectonic origin and located close to the shore. The average slope down to depths of 1700-1900 meters varies between 6 and 10 degrees, and in some places the steepness reaches 20 and even 30 degrees. The transition to the bottom of the depression is smooth and gradual here. West of Yalta, the slope is less broken, and the single bench drops to a depth of about 2,000 meters (the angle of dip averages about 10 degrees) with a sharp transition to a very flat, almost horizontal, surface of the deepwater basin of the sea. At the same time, this portion

of the slope is considerably removed from the shore line. The transition zone between the two described parts is characterized by being the most complex as to bottom relief of the given region. The continental slope south from the Kerchenskiy Proлив differs, having even, smooth relief forms and a small over-all dip of the bottom surface (1-3 degrees).

In arranging the seismic investigations, the experience of foreign works in the oceans (M. Ewing, et al, Bull. Seismol. Soc. Am., Vol 40, No 3, 1950; and others), work on deep seismic sounding in the Caspian Sea (Ye. I. Gal'perin and I. P. Kosminskaya, Izv. AN SSSR, ser. geofiz., No 7, 1958), and works of the Institute of Oceanology during preceding years (A. P. Lisitsin, I. Ye. Mikhal'tsev, and others, DAN, Vol 115, No 6, 1957; and Yu. P. Neprochnov, DAN, Vol 125, No 5, 1959) were used. In addition, an analyzer (five narrow-band amplifiers with maximum frequency characteristics of 30, 50, 100, 500, and 1,000 cycles) was used which considerably facilitated deciphering the recordings of water waves. As a result, the accuracy of determining the distances from the points of the explosions was increased.

Recording was conducted on the expeditionary ship Akademik S. Vavilov (The recording points (stations) are shown in Figure 1, 12-18); the explosions of the charges weighing from 0.4 to 130 kilograms were made from an auxiliary ship moving along the profile. The intervals between explosions varied from one to 5 miles.

The direct and repeatedly reflected waves in the water layer and the waves refracted by the boundaries of separation in the Earth's crust are clearly defined. For refracted waves related to the principal deep boundaries, lead (vstrechnyye) hodographs were obtained along profiles X and XIII, and along profile XI lead and following (nagonyayushchiye) hodographs were obtained. With correlation waves and for the construction of seismic profiles, methods were applied which were developed for the correlation method of refracted waves (KMPV) (G. A. Gamburtsev, Yu. V. Riznichenko, and others, The Correlation Method of Refracted Waves, M. 1952) and deep seismic sounding (GSZ) (G. A. Gamburtsev, DAN, Vol 87, No 6, 1952; and P. S. Veytsman, Izv. AN SSSR, ser. geofiz, No 12, 1957); taking into account the previous seismic work in the Caspian, Japanese, and Black seas.

In Figure 2, the seismic section along profiles X and Xa is shown. The depth of the sea according to these profiles is constant and is equal to about 2,150 meters. Below the bottom lies a layer with a mean velocity of propagation of longitudinal seismic waves of $V = 3.0$ kilometers per second (the velocity is determined according to the points of intersection of hodographs of refracted waves) According to the value V , this layer can belong to the sand-clay types of sedimentary rock. The thickness of the deposits increases according to profile X in a western direction from 8-12 kilometers. Judging from the hodograms of refracted waves, the sedimentary layer is comparatively homogeneous but has some refracting

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boundaries. One of these boundaries was successfully constructed because of more detailed observations on the Xa profile. This boundary is characterized by a velocity of $V_g = 3.0$ kilometers per second and lies almost horizontally at a depth of about one kilometer below the bottom of the sea. The refracted waves connected with a similar boundary, are distinguishable also in the eastern and western ends of profile X and in the southern portions of profiles XI and XIII. (In the section shown in Figure 2, the portions of the boundary which are constructed with accuracy are shown by thin lines and dots.) The described layer, on the basis of the value of velocity, can belong to a sandstone type rock strata. The available data do not permit an opinion of the thickness of this strata. Additional observations are necessary for a more detailed separation of the sedimentary stratum.

The sedimentary strata are underlaid by rock with a boundary velocity of $V_g = 6.8$ kilometers per second. The velocity of such an order is usually characteristic of the basalt layer of the Earth's crust. (Here and further on in the article, the terms "granitic" and "basaltic" layers, which are universally used in geophysics, are used. In the "granitic" layer are also included metamorphic sedimentary rock.) In the construction of the underlying boundaries, it was accepted with a certain approximation that the basalt layer has a maximum stratum velocity of $V_p = 6.8$ kilometers per second. In this case, the thickness of the basalt layer according to profile X is equal to 15-20 kilometers. Under the basalt layer lies a boundary with a velocity of $V_g = 8.4$ kilometers per second, which can be related to the Mohorovicic discontinuity. We note that because of the insufficient length of the profile, the depth and the velocity V_g of this boundary are not positively determined.

Thus, according to profile X, a two-layer crust is obtained. A typical granitic layer was not observed. The total thickness of the Earth's crust (including the water layer) here is equal to 28-30 kilometers. A similar structure was obtained also for the southern portions of the XI and XIII profiles.

In the northern portions of profiles XI and XIII, it was not possible to carry out a precise correlation of the waves and the determination of the parameters of certain boundaries of separation because of the very complex wave picture. However, a general outline of the structure of the Earth's crust was positively fully developed. Here, there is a granitic layer (V_g 5.8-6.0 kilometers per second) which gradually tapers out in a southerly direction. The southern boundary of the propagation of the granitic layer in the region studied is plotted in Figure 1.

Along profile XIII, the surface of the basalt layer plunges from south to north from a depth of 12-13 kilometers down to a depth of about 20 kilometers. The thickness of the granite layer was not positively determined. In the region of the continental slope, the profile

lies in the region of the deepwater basin, it is approximately equal to 4-6 kilometers. The Mohorovicic discontinuity, according to this profile, lies in the region of the deepwater basin at a depth of 30-33 kilometers and also plunges in a northern direction. At a point 44 kilometers south of station 18, its depth reaches 36 kilometers.

Along profile XI, the surface of the basalt layer, to the contrary, experiences a gradual rise to the north. Not far from the shore of the Crimea, this boundary lies at a depth of about 10 kilometers. It is interesting that the region of the principal continental slope is marked by a step-shaped kink in the surface of the basalt layer. The granite layer tapers out from north to south at a distance of about 100 kilometers from the shore line. According to the available data, it was possible to construct only a small portion of the surface of the granite layer in the region of tapering. The behavior of this region on the north end of the profile is still not clear. The Mohorovicic boundary along profile XI is not constructed because of insufficient length of the profile.

On profile XIa, rapid changes are noted in two places on the hodographs, which it is hypothetically possible to connect with fractures in the strata (faults) of the upper part of the Earth's crust. This hypothesis is supported by the fact of the poorest passage of seismic waves along profiles XI and XIa in comparison with the other profiles and also by bathymetric data. For obtaining more accurate information concerning this extremely interesting section, it is necessary to conduct special detailed research.

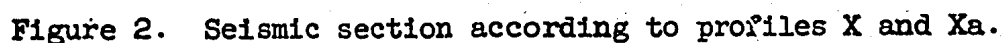
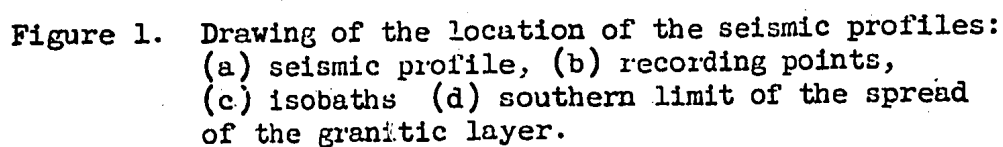
As is known, a large number of earthquakes occur in the region of the continental slope southeast of Yalta. G. P. Gorshkov and A. Ya. Levitskaya link these with the system of deep overthrusts in the Earth's crust (G. P. Gorshkov and A. Ya. Levitskaya, Byull. MOIP, otd. geol., Vol 22, No 3, and 31, 1947). The details contained in the described seismic investigations are insufficient for a final solution of the problem of the existence of deep fractures here. However, it is extremely probable that the discontinuity of the basalt layer in the region of the continental slope noted along profile XI is directly connected with these phenomena.

As a comparison shows, the structure of the Earth's crust in the central part of the Black Sea basin is similar in general outline to the structure of the Earth's crust of the southwest of Crimea beyond the limits of the continental slope (Yu. P. Neprochnov, DAN, Vol 125, No 5, 1959). It is possible to note only a certain difference in the values of the boundary velocities and in the thickness of the layers. In the region to the southwest from Crimea, the thickness of the Earth's crust is less than in the central part of the sea, mainly because of a decrease in the thickness of the basalt layer.

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Seismic data concerning the structure of the Earth's crust under the Black Sea aid in explaining the reasons for certain peculiarities of the gravitational field in this region. Thus, for example, not long ago our attention was turned to the fact that the mountainous part of Crimea, in contrast to other elevations of the Alpine geosynclinal region, is characterized by great positive anomalies of gravity in the Bouguer reduction (A.D. Arkhangel'skiy, Byull. MOIP, otd. geol., No 7, pp 1-2). On the basis of the described results of the seismic investigations, it is possible to conclude that the prevalence of positive gravitational anomalies over the Crimean Mountains is obviously, to a considerable degree, connected with the rise in the surface of the basalt layer.

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Experience of Modernizing Type SVK and SGK Seismographs
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Waves of different types, excited by earthquakes and by powerful explosions, are essentially characterized by different spectra. Therefore, it is difficult to record waves of all types on one set of seismographs simultaneously. In this connection, several seismograph sets (5-7) are established in modern seismic stations, each of which is tuned to a specific band of transmission and serves for recording only a specific type of wave.

Type SVK and SGK seismographs of D. P. Kirnos design and B. B. Golitsyn design seismographs (Savarenskiy, Ye. F. and Kirnos, D. P., Elementy Seysmologii i Seysmometrii, (Elements of Seismology and Seismometry) Gostekhteorizdat, M., 1955) are used in the USSR for recording surface, longitudinal, transverse, and surface waves of near and distant earthquakes, i.e., in a wide range of periods.

At present, seismographs making it possible to record oscillations with periods up to 25-30 seconds and more (type B. B. Golitsyn and SVK and SGK seismographs with M-21 type galvanometers [Moskvina, A. G. and Shebalki, N. V., "Frequency Characteristics of Pulkovo Station Seismographs, Izv, AN SSSR, ser. geofiz., No 11, 1953; "Magnetoelectric Reflector Type M-21 Galvanometers, TsBTI, MESEL., 1953] are used for registering surface waves. Foreign stations also use seismographs for recording surface waves with periods of 600 seconds and higher.

In work with type SVK and SGK instruments, because of the presence of steady characteristics, the determination of the true periods and amplitudes of the oscillations, important for interpretation of the dynamic characteristics of waves (Kirkos, D.P. and Kondorskaya, N. V., "Calculation of the True Values of the First Amplitude of the Soil Motion With the Arrival of a Seismic Wave," Izv, AN SSSR, ser. geofiz., No 9, 1958) is considerably simplified.

The sensitivity of type SVK and SGK seismographs was found to be insufficient in recording relatively weak earthquakes with a magnitude M of about 4 and less, and the distance for the registration of body waves, according to arrivals of which a determination of the coordinates of the epicenter and the depth of the foci are made, is small and usually consists of about 600 kilometers (Bune, V. I., "On the Classification of Earthquakes According to the Energy of Elastic Waves Radiated From the Focus," Dokl. AN Tadzh. SSR, No 14, 1955). As a result of this, weak near and distant earthquakes are recorded only by a small number of stations and sometimes only by one station nearest the epicenter. This does not guarantee the study of weak near and distant earthquakes.

In the regional stations located in the seismically active regions, D. A. Kharin (VSKh and GSKh) design seismographs are also installed. Usually these seismographs have nonuniform frequency characteristics with a maximum amplification for periods of 0.3-0.4 seconds of about 30,000 (Saverenskiy, Ye. F. and Kirnos, D. P., Elementy Seysmologii i Seysmometrii Elements of Seismology and Seismometry), Gostekhtheoretizdat, M., 1955). However, while the narrow pass band of these instruments ensures good registration of local earthquakes, it does not guarantee the sharp recording of the arrival of body waves at sufficiently great distances (over 500-600 kilometers), near earthquakes with $M < 4$, and also body waves of relatively weak distant earthquakes.

Seismographs satisfactorily registering longitudinal waves of weak local, near, and distant earthquakes are the electrodynamic seismographs, types SVK-M and SGK-M, with a narrow frequency characteristic. These are the vertical and horizontal type seismographs, SVK and SVG correspondingly, which were modernized by the authors and adjusted for experimentally selected parameters.

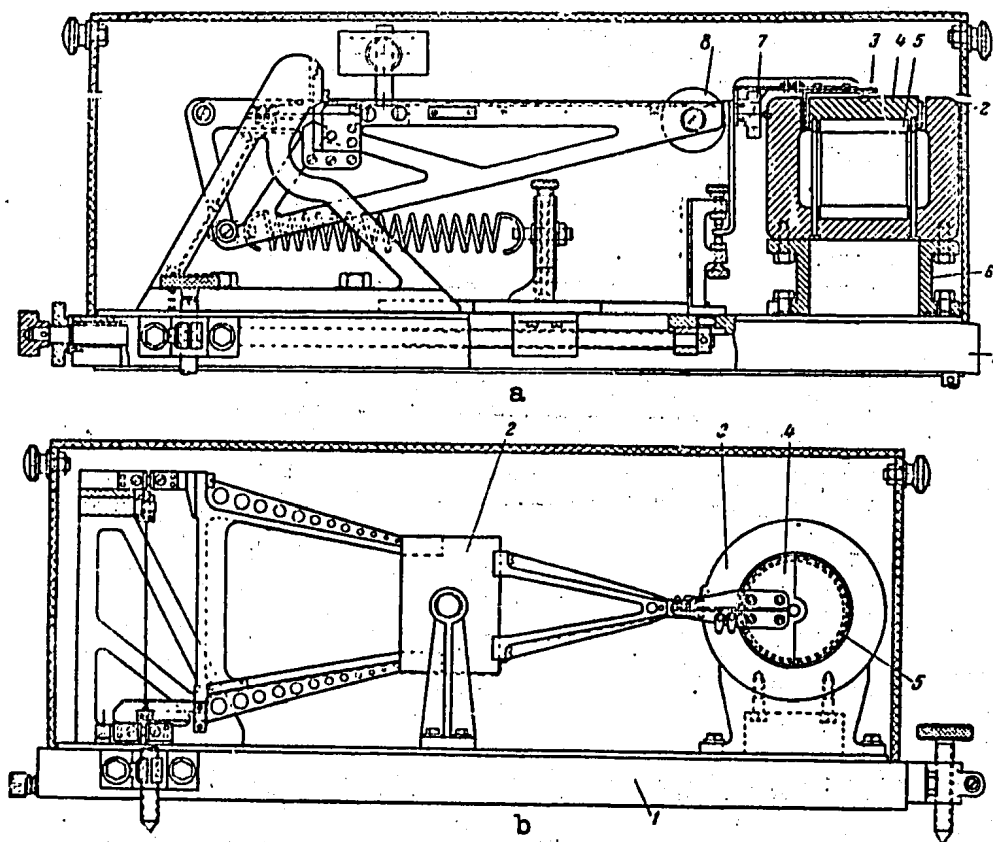


Fig. 1. General view of Seismographs.
 (a) Type SVK-M: (1) base; (2) magnetic circuit; (3) coil;
 (4) pole terminal; (5) Magnet; (6) magnetic circuit stand;
 (7) scale; (8) moving mass.
 (b) Type SGK-M; (1) base; (2) moving mass; (3) magnetic
 circuit; (4) magnet; (5) coil.

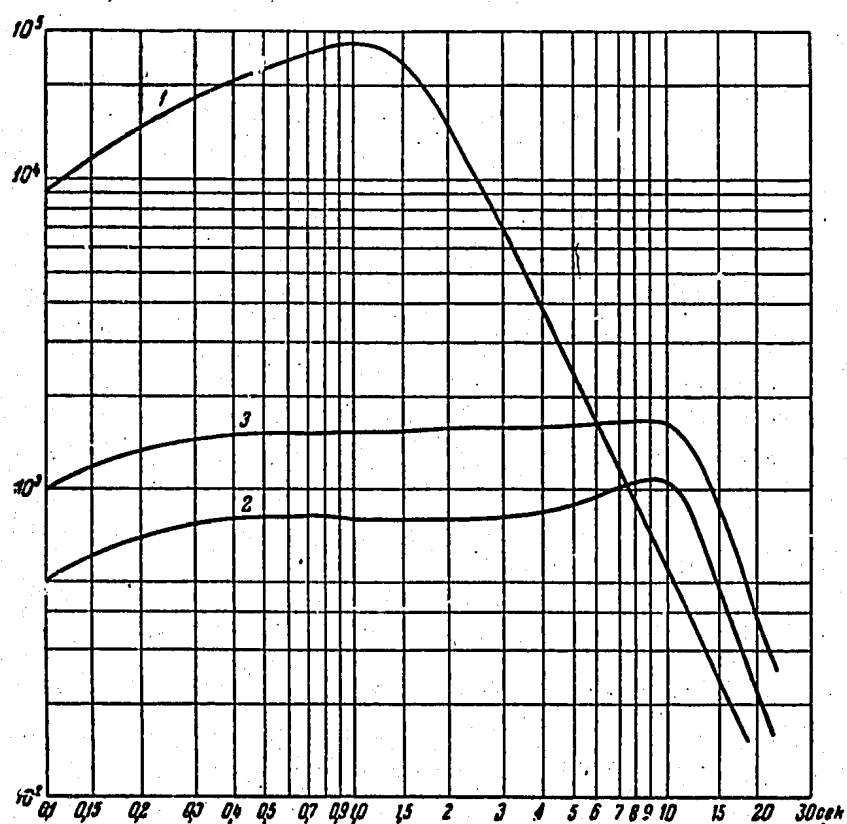


Figure. 2. Magnification Curves of Seismographs

1. Type SVK-M, connected to the Gk-VI type galvanometer
($T_1 \approx 2.5$ sec, $T_2 \approx 1.1$ sec., $D_1 = 1.5$, $D_2 = 3$, $\sigma = 0.25$);
2. Type SVK;
3. Type SGK, adjusted for standard constants.

A short description of these seismographs and certain results of work with them follow.

Working Principles of the Seismographs

The horizontal and vertical electrodynamic seismographs, types SVK-M and SGK-M, are, correspondingly, type SVK and SGK seismographs, the magnetic systems of which are replaced by spherical systems (Groshevoy, G. V., "Problem of Designing and Calculating Magnetic Systems for Geophysical Instruments," Tr. Geofiz. in-ta AN SSSR, No 20, 1958) and the flat coil types by cylindrical systems (calculation of magnetic systems made by G. V. Groshev). The magnetic flux of the system reaches about 200,000 microseconds, and thus its diffusion is considerably less than that of the magnetic systems of the SVK and SGK type seismographs.

The location of the mass in the suspension of the pendulum is also changed in the vertical seismograph; the mass located at the end of the pendulum near the coil is considerably increased, and the masses from the opposite end of the suspension are removed.

A general view of the SVK-M and SGK-M seismographs is shown in Figure 1, and their design data are presented in Table 1.

The magnetic circuit of the magnetic system is made of Armco iron and the magnet from Magnico alloy. The coil frame is made of organic glass on which two windings are located: the operating coil switching on the galvanometer and the damping coil. Damping of the pendulum is done electromagnetically by eddy currents generated in the windings of the coil during its motion in the magnetic field. Damping can be controlled within wide limits by means of changing the resistance of the bypass coil of the damping winding. The operating coil of the seismograph coil is designed for inclusion in existing types of galvanometers, types GK-VII, M-21 ("Magnetolectric Reflector Type M-21 Galvanometers," TsBTI, MESEL, 1953), and others, for obtaining frequency characteristics with a narrow pass band from 0.3 to 1.5-2.5 seconds and more. It is also possible to adjust instruments in other transmission bands as the periods of seismograph pendulums can be regulated within the wide limits from tenths of a second up to 4-5 seconds and more by means of changing the tension of the flat springs of the horizontal seismographs and the tension of the flat and spiral springs of the vertical seismographs.

For easy and reliable operation of the instruments, the radial clearance in the magnetic system of the seismograph selected is relatively large (5 millimeters). The large radial clearance and also the considerable diameter of the coil were selected according to design and operation considerations: this resulted in considerable dimensions for the magnetic system (the diameter of the magnetic circuit is 150 millimeters, and the height, 110 millimeters) and its considerable weight (about 14 kilograms),

which is a certain shortcoming of the construction. However, the stability in operation of the instruments thus obtained (in some stations the instruments have operated over 5 years without adjustment) compensates for these shortcomings.

The changes in construction which are noted permitted a considerable increase in the sensitivity of the seismographs and leads to their operating magnification in a narrow, but not too narrow, part of the frequency characteristics in a range of periods from 0.3-0.6 to 1.5-2 seconds, up to 20,000-30,000 with a comparatively sudden clipping of the frequency response in the longer periods. This made it possible to decrease the level of the background microseisms with periods over 4-5 seconds on the seismograms and to considerably raise the ratio of the amplitude of the effective oscillations to the amplitude of the disturbances.

Seismographs with a narrow pass band are subject, to a considerably lesser degree, to temperatures, microfluctuations of atmospheric pressure, and other factors. Therefore, these seismographs operate satisfactorily when set up in locations in which temperatures change sharply and also when set up directly in the field.

T a b l e 1

<u>Design Data</u>	<u>Unit</u>	<u>Type of Instrument</u>	
		<u>SVK-M</u>	<u>SGK-M</u>
Weight of pendulum	g	5,000	5,000
Equivalent length of pendulum	cm	27	29
Moment of inertia of pendulum	g/cm ²	3.2-3.8 : 10 ⁶	2.5 - 3.0 · 10 ⁶
Periods to which pendulum can be adjusted	sec	0.1 - 10 - 12	0.1 - 10 - 15
Impedance of excitation coil	Ohm	300-600	300-600
Impedance of damping coil	Ohm	300-100	300-100
Approximate value of current constant with pendulum adjusted at T ₁ = 2.5 sec	a/mm/m	2 : 10 ⁻⁵	2 : 10 ⁻⁵
Total weight of the seismograph	kg	50	50
Dimensions	cm ³	70 : 30 : 30	70 : 30 : 30

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Table 2

Type of Instrument	Type of Galvanometer	Instrument				Constants			
		T_1, sec	D_1	T_2	D_2	σ^2	\bar{V}	V_m	T_m
SVK-M	GK-VI	2.5	1.46	1.1	3.0	0.24	19000	16000	0.2-1.5
SGK-M	GK-VI	2.0	2.4	1.2	1.2	0.30	46000	20000	0.4-1.4

**Optimum Pass Band for Registering Body Waves of Near Earthquakes
and Longitudinal Waves of Distant Earthquakes**

The SVK-M and SGK-M type seismographs were used by the authors since 1951 during seismic investigations conducted by the Institute of the Physics of the Earth, Academy of Sciences USSR in different regions of the USSR and also in Antarctica (Kogan, S. D., Pasechnik, I. P., and Sultanov, D. D., "Seismic Observations of Soviet Seismic Stations in Antarctica," Annaly MGG [Annals of the IGY] M., 1959). Observations were simultaneously conducted on SVK and SGK type seismographs and several other types of seismographs. Type SVK-M seismographs are now operating in Tiksi, Mirnyy, and other stations.

During the many investigations, it was experimentally established that for recording the longitudinal and transverse waves of near earthquakes, the optimum pass band in the overwhelming majority of cases is the range of periods from 0.3-0.5 up to 1-1.5 seconds. With the adjustment of the instruments for the indicated pass band, the highest ratio of the amplitudes of the effective oscillations to the amplitude of the microseisms was noted. In the work (Moskvina, A. G., and Shebulki, N. V., "Frequency Characteristics of the Pulkovo Station Seismographs," Izv. AN SSSR, ser. geofiz., No 11, 1953), it was experimentally established that for a number of USSR seismic stations, the amplitudes of disturbances were at a minimum, specifically for periods of about one second.

In Table 2, the parameters for which the SVK-M and SGM-K [sic] seismographs installed in some stations in the Soviet Union and Antarctica are adjusted are given. The designation of constants used is the same as that in the bulletins of the net of USSR seismic stations (Byulleten' seti seysmicheskikh stantsiy SSSR, No 1, Jan/Mar 1955, Izd AN SSSR, 1956). The magnification curves of the SVK-M, SVK and SGK type seismographs are given in Figure 2.

It should be noted that, depending on the character of the microseisms at the stations, the characteristics of the instruments have to be changed somewhat by shifting the pass bands into the region of either shorter or longer periods and also by varying somewhat the width of the pass band. For example, seismographs of the type SVK-M are more sensitive in the recording of longitudinal waves of remote earthquakes than the seismographs of the type SVK; Figure 3 [not reproduced here; captions of Figures not reproduced appear at end of item] shows recordings of a direct longitudinal wave P of a remote earthquake with an intensity of $M \approx 5$, obtained at the Mirnyy Station in Antarctica on type SVK-M and SVK seismographs.

Whereas on the recording of the type SVK-M (Figure 3, a) seismograph, the arrival of the wave P with an apparent period of oscillations of 2 seconds with an amplitude of the first extremum of 5 millimeters is distinguished very clearly, the arrival of this wave is practically indistinguishable on the recording of the type SVK seismograph.

The place of arrival of the waves on the seismograms is indicated by arrows. At the same time, the background of microseisms on the recordings of the SVK seismograph is somewhat larger than on the recordings of the type SVK-M seismograph.

Figure 4 [not reproduced here] shows a recording of the P wave obtained by the seismograph type SVK-M at a distance $\Delta = 2,650$ kilometers during an underground explosion of 1,000 tons of chemical explosives set off near the Arys' station of the Tashkent railroad. The seismic waves M during the explosion had an intensity rating of 4, as determined by the surface waves.

During this explosion, the SVK seismographs successfully recorded volumetric waves only up to distances of 600-700 kilometers (Butovskaya, Ye. M., Ulomov, V. I., Dzhunisov, M. A., and Yakovlev, V. N., "A Hodograph of Seismic Waves and Certain Peculiarities of the Structure of the Earth's Crust in Central Asia According to Recordings of Powerful Explosions," Otchet. Fondy In-ta Matematiki AN UzSSR, Tashkent, 1958).

It should also be noted that, in the case of nearby earthquakes with $M \approx 4$, on the recordings of the SVK-M and SGK-M seismographs, in a number of cases, the arrival of body waves was distinguished at distances of up to 1,000-1,500 kilometers, while, at the same time, no body waves were recorded on the SVK and SGK seismographs under the same conditions. As an example, Figure 5 [not reproduced here] shows recordings of an earthquake of 5 August 1958 according to seismographs type SVK (Figure 5, a) and SVK-M (Figure 5, b). From a comparison of these seismographs, it is evident that the amplitudes of the oscillations on the recording of the SVK-M seismograph are considerably larger than on the recordings of the SVK seismograph. A recording of the same earthquake obtained on an

automatic ink-recorder (so-called visible recording) at the same point where the recordings for Figure 5, a and b were obtained is shown on Figure 5,. From these recordings, it is evident that the amplitudes of the body waves on the seismogram obtained with the self-recorder, for example, are ten times as large as on the recording of the SVK-M seismographs with galvanometer registrations. This indicates that there are real possibilities of considerably improving the effectiveness of the sensitivity of a seismo-receiving channel.

We should also note that with instruments of the SVK-M and SGK-M type good recordings were made (in Moscow), for example, of the Krasnopolyansk earthquake of 27 December 1956 with a force of 7-7 1/2 and a number of others which were recorded only weakly or not at all on the SVK and SGK instruments.

As a result of higher resolution of the instruments, together with a narrow pass band on the recordings, it is possible, as a rule, to distinguish a greater number of arrivals of longitudinal waves than on the recordings of the wide-band instruments, especially in those cases in which the recordings are sufficiently distinct. As an example, Figure 6 [not reproduced here] gives recordings of a remote earthquake with an magnitude of $M = 6.5 - 7.1$ on the wide-band (SVK) instrument and on an instrument with a narrow pass band (SVK-M).

As is evident from a comparison of the recordings presented, in a seismogram from an SVK-M instrument it is possible to distinguish a considerably greater number of wave arrivals directly following the first wave than in recordings from a SVK type seismograph.

The great advantage of an apparatus with a compressed pass band in the range of periods from 0.5 to 2.5-3 seconds is that it permits separation of arrival of waves quickly following one another (for example, waves of the type p_p , p_s and others) in seismograms obtained with this instrument.

In this case, waves which are distinguished in times of arrival by a small interval (of several seconds) are registered on the recording separately and do not interfere with one another as in the case when a wide-band apparatus is used. An apparatus with a compressed pass band and properly selected parameters (sufficient attenuation) has greater resolution than a wide-band or narrow-band apparatus. Due to a more legible entry of longitudinal waves on recordings of SVK-M and SGK-M type seismographs, it is possible to determine the times of their arrival, as well as the azimuths at the epicenter, with greater accuracy than in recordings from SVK and SGK type seismographs.

It should be noted that in a number of recordings from SVK-M and SGK-M type seismographs a less intense wave was observed which arrived 2-3 seconds before the main wave. This wave was not registered by SVK or SGK type seismographs.

The considerable increase in the effectiveness of operations of seismic stations upon being equipped with the modernized SVK-M type seismographs is illustrated by maps of earthquake epicenters in the subantarctic zone which were compiled according to observations by Soviet seismic stations in Antarctica and also to maps of earthquake epicenters registered by stations indicated in the work (Kogan, S. D., Pasechnik, I. P., and Sultanov, D. D., "Seismic Observations by Soviet Seismic Stations in Antarctica," Annaly MGG [Annals of the IGY], Moscow, 1959).

At the present time, SVK-M and SGK-M type seismographs with the compressed band have been sufficiently widely tested and may be recommended for installation at permanent operating seismic stations in the USSR. Captions for figures 3, 4, 5, and 6, which are not reproduced here.

Fig. 3. Recording of the direct longitudinal wave P of the 1 June 1957 earthquake at 0754:40 hours (4.5 S, 129 E, north of the Moluccas Islands, $h \sim 100$ kilometers, M about 5, $\Delta = 7270$ kilometers), obtained at station Mirnyy.

- (a) On the vertical seismograph, type SVK-M, with a magnification of about 20,000;
- (b) On the vertical seismograph SVK with a magnification of 900; recording of the arrival of P waves on the SVK seismograph hardly differs.

Fig 4. Recording of direct longitudinal wave of a subterranean explosion equal to 1,000 tons of chemical explosives made on 19 December 1957 by a SVK-M type seismograph at an epicentral distance of $\Delta = 2650$ kilometers, $M = 4.0$.

Fig. 5. Recording of 5 July 1958 earthquake at 0205:57 hours (43 N, 41.5 E, $\Delta = 1350$ kilometers, $M = 4 \frac{3}{4}$).

- (a) On standard apparatus (type SVK seismograph); (b) On a narrow pass band apparatus (type SVK-M seismograph); (c) On a type SVK-M seismograph connected to an automatic ink recorder.

Fig 6. Recording of the 23 March 1957 earthquake at 0512:45 hours (5.5 S, 131 E, Banda Sea, $h = 100$ kilometers, $M = 6.5-7.1$, $\Delta = 7,190$ kilometers) obtained at station Mirnyy.

- (a) On standard apparatus with standard constants (type SVK seismograph); (b) On the type SVK-M vertical seismograph.

("Experience of Modernizing the Type SVK and SGK Seismographs," by I. P. Pasechnik and N. Ye. Fedoseyenko, Institute of the Physics of the Earth, Academy of Sciences USSR; Moscow, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 12, Dec 59, pp 1853-1860)

V. ARCTIC AND ANTARCTIC

Soviet-Antarctic Flight Operations

The aviation detachment of the Fifth Complex Antarctic Expedition, under A. Pimenov, left Leningrad on the diesel-electric ship Ob' in November of 1959. It arrived in Antarctica on 11 January 1960 and has already begun operations.

Flights have been made from the polar stations of Mirnyy and Lazarev. Flying out of Lazarev in a ski-equipped Li-2, A. Barabanov, pilot, made an aerial photographic survey of Queen Maud Land. V. Sysoyev, using a ski-equipped An-2, makes regular flights to different points in Queen Maud Land supplying Soviet field parties there with food supplies and equipment.

An Li-14 commanded by A. Pimenov, with Yu. Zotov, second pilot, I. Kukhar', navigator, V. Gladkov, crew chief, and P. Poyko, radio operator, recently made a 3,100-kilometer nonstop flight from Lazarev to Mirnyy.

According to a radio report from Pimenov, the flight was made at an altitude of 5,000 meters under unfavorable navigational conditions. Along the flight route, mountains which were not indicated on the maps were found. The flight lasted 11 hours and 30 minutes.

A. Pimenov, D. Barabanov, V. Sysoyev, and Yu. Zotov came to polar aviation from the Soviet Air Force. These former military flyers possess the necessary experience and skill to perform competently flights over the expanses of Antarctica. ("Over the Expanses of Antarctica," by M. Filipenin; Moscow, Sovetskaya Aviatsiya, 24 Jan 60, p 4)

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